Gas Journal

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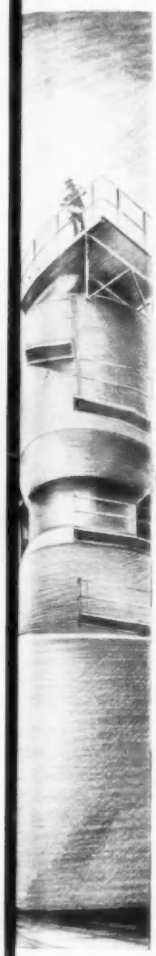

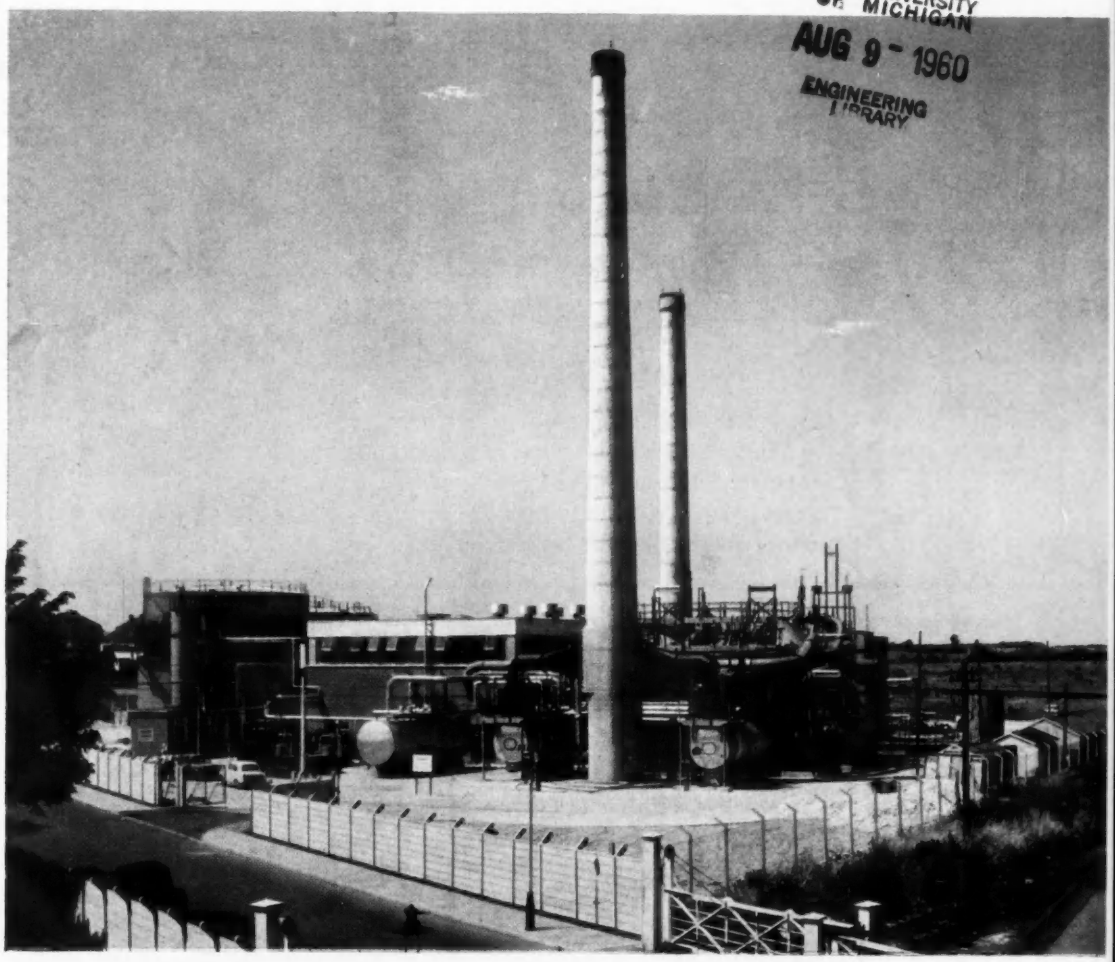

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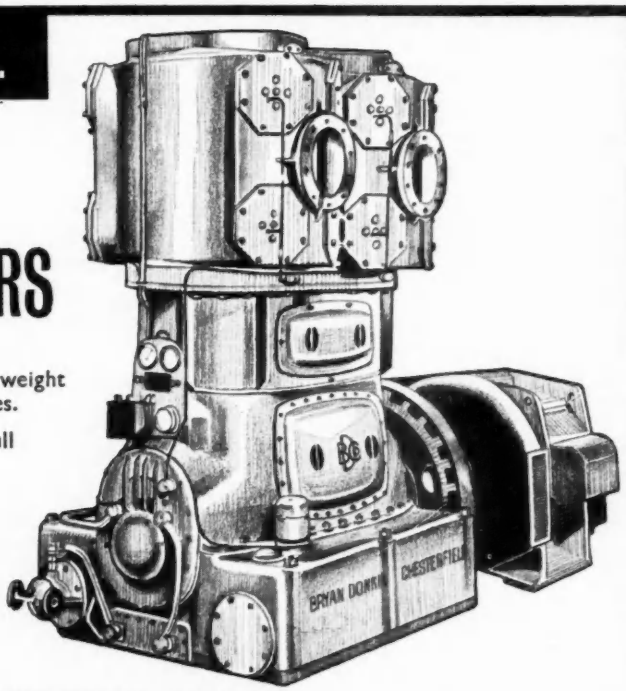

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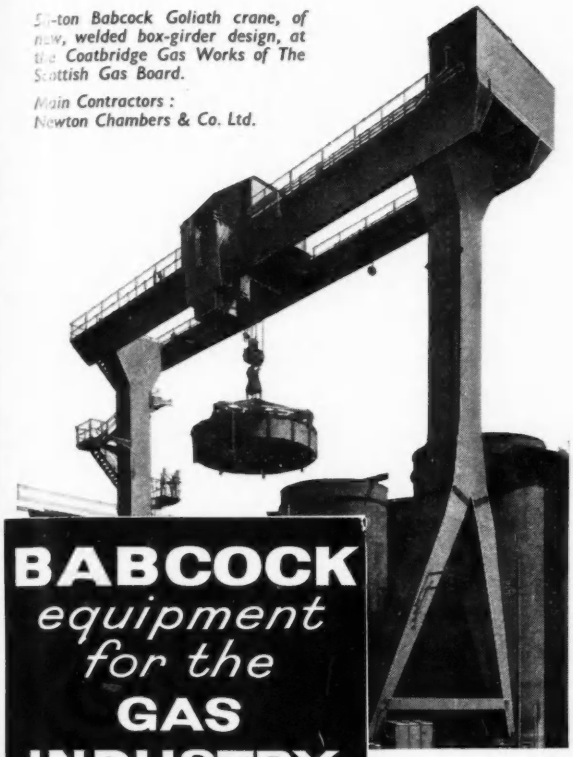

5½-ton Babcock Goliath crane, of new, welded box-girder design, at the Coatbridge Gas Works of The Scottish Gas Board.

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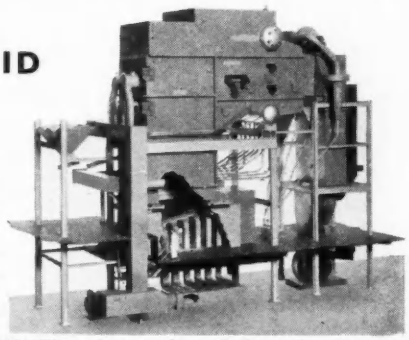

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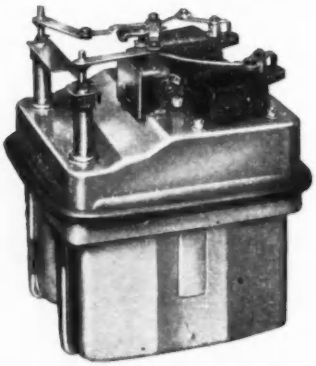

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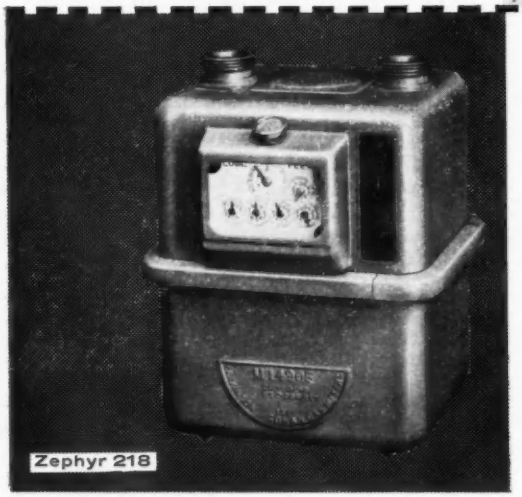

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Gas Journal

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The importance of water treatment

THE treatment of boiler feed water for steam raising is clearly of great importance, but until recently it has not had the attention paid to it by the gas industry which it deserves. This is understandable, since steam raising has been something of an ancillary activity of the industry in the past. In the days of the small works steam was the chief source of power. But the cost of its generation was of secondary importance, its pressure was low, and the need for a standard type of water was not so pressing as it has become in the last decade.

The paper on water treatment by Mr. L. G. Townsend, Chief Chemist of the Mersey Group of the North Western Gas Board, which we are publishing this week, is most timely. Although we publish articles and papers on this subject from time to time, the background to water treatment would appear to be of greater interest to the chemist than to the engineer, and so it tends to be passed over when authors are deciding upon a theme on which to write their papers. Its importance, especially since the war, has increased enormously. The consumption of water by all users has risen steeply. Industry and agriculture are now using enormous quantities daily, and the demands made by the domestic user are increasing as housing conditions improve and better standards of life call for properly installed water systems.

Water has therefore become an exceedingly valuable commodity in its own right and no one can afford to waste it.

With the development in the past two decades of the building of individual pieces of equipment of ever increasing capacity, often involving higher and higher pressures, it is essential that the quality of the raw materials used should be maintained as constant as possible and impurities kept to a minimum. The high pressure, high capacity boilers now being constructed for electrical generating stations have made it necessary that something akin to distilled water should be used as boiler feed. Under the conditions of high pressure and therefore of high temperature within these boilers, certain impurities in the feed water, otherwise of little importance, may become corrosive, and the depositing of scale may well cause considerable mechanical strain on the boiler itself.

Though such severe conditions may not yet apply to steam raising in gasworks, the tendency since the war to build thermally-integrated gas-making plants has underlined the importance of the smooth, uninterrupted working of waste heat boilers, and water treatment plants are now becoming a common feature of the modern gasworks.

Since the quality of water varies so greatly with its source, considerable care must be taken with the individual design of water treatment plant to carry out the specific needs for the use to which the water will be put. In the gasworks, water is needed for steam raising, cooling and gas washing. Though chemical treatment may only be needed for steam raising considerable ingenuity may have to be used to make the maximum use of the water for all purposes. The progressive use of high pressure steam for driving electrical turbines, through exhausters to process work, will be necessary if the maximum use is to be made of the costly water treatment plant, but an integrated layout for the water to be supplied to the gas washers, the gas cooling and the condenser plants will also be needed, if the available water is to be used with the maximum efficiency.

Mr. Townsend has divided his paper into two main sections, in the first of which he discusses the objectives at which the water treatment chemist is aiming and the methods and reagents at his disposal, and in the second section, he describes some of the results realised in the treatment of water at the Liverpool gasworks of the Mersey Group.

Unfortunately shortage of space only allows us to publish the first section of the paper, which deals almost exclusively with the treatment of boiler feed water. Certain references in the paper to the appearance of slime in cooling wells and the cause of blockages in water pipes we found most interesting as we did Mr. Townsend's reference to the fouling of gasholder water involving the generation of sulphuretted hydrogen by bacteria.

The conversion of water from natural sources into a pure product comparable with, or even better than distilled water by purely chemical means is a considerable achievement, especially when it is realised that it can be done on a scale big enough to supply the largest boilers now being built. It is, however, exceedingly costly when very hard waters are to be treated. In a great many cases it may not be necessary to go quite so far as this, and a water of intermediate quality may serve equally well. Here we thought the paper was particularly helpful and gave a clear and concise reason why certain treatment was necessary and explanation of its effect on the boiler.

Water treatment has gone a long way since the days when many engineers were content to rely on a reasonable boiler performance by adding soda ash to their feed water. This treatment combined with periodical blow down, kept the scale-forming constituents in th form of a sludge, and were easily discharged to main tain a constant proportion of totally dissolved solids Today the tendency is to replace those solids by sub stituting their cation by hydrogen, thus obviating th disadvantage of many of the older treatments by whic the proportion of total dissolved solids might increase The use of zeolites does much to avoid the disposal o accumulated sludge waste from treatment plants, without in fact changing the proportion of dissolved solids.

The size of the problems to be tackled is impressive and the ingenuity with which they have been solved is most interesting. Here is yet another example of the backroom boy making possible considerable developments in plant design.

Mr. Townsend has taken considerable pains to stress the importance of the right type of water for any particular purpose. This is further demonstrated by a subtle change of emphasis by the plant manufacturers. At one time such plants were generally known as 'water softeners,' but today they are referred to as 'water treatment' plants. It is in this change from 'softened' to 'treated' water that the greatest development of modern treatment lies. If one submits water samples to the plant manufacturer, telling him for what purposes it will be used, an appropriate plant will be designed.

New advisers for the Minister

IT is significant that the Minister of Power should not only have reconstituted his Scientific Advisory Council, but that he should have also renamed it the Council on Research and Development. With Sir Alexander Fleck as its Chairman and Captain (E) W. Gregson as its Deputy Chairman, problems facing the fuel industries should be effectively presented to the Minister by this very representative body.

Research and development are clearly the most fundamental issues facing industry in general at the present time, and particularly so in the highly competitive world of fuel usage. Campaigns to encourage the greater use of our indigenous fuels will have little effect on the industrialist who has to buy the most suitable fuel in the cheapest market, if they are not based on sound reasoning and sound economics.

So often Great Britain seems to have been unable to translate into industrial processes the very considerable advances she has made in fundamental research. Other countries, particularly America and to a smaller extent Germany, have shown in the past considerable ability and skill in developing plant designs based on British fundamental research. Great Britain has subsequently had to re-import these ideas in their new guise. Research then will continue and it is our hope that development will be given the importance it deserves.

Is there more significance in these changes than would be detected by a casual reading of a list of distinguished names representing not only the fuel industries, but also science and technology, from the Ministry itself, the National Coal Board and the University of Sheffield?

Professor M. W. Thring is well known for his outspoken criticism of the slowness with which new knowledge is used by the British fuel industries and the ease with which plant and processes are imported from abroad by industry. It should be his rôle at least to stress the development side of the Council's activities.

Mr. W. K. Hutchison's appointment to the Council should keep the gas industry's views on the best uses of fuel consumed by both industry and the housewife well to the fore. As one of the country's leading chemical engineers, his understanding of plant design should also be of the greatest assistance in making the fullest use of available fuels.

But does the constitution of the new Council go even further towards combining the use of the fuel resources available? Does it mean that the Ministry means to put in hand far more extensive plans for the use of secondary fuels derived from British coal?

This may well be so, and may well include such ancillary activities as improved handling facilities for solid fuels and better heat control in modernised furnaces for their use.

As an industry, we generally pride ourselves that such conversions are best accomplished by substituting gas-firing for coal-firing, but other means of converting coal into a more easily-handled fuel may well be round the corner. This will be for the Council to consider, but we feel that there is little doubt that some form of coal gasification will be the best way of modernising our fuel systems. Oil has set the pace, but coal-based gas must outstrip it.

To these and other questions the newly constituted Council should be well equipped to give a satisfactory reply.

DEVELOPMENTS ON THE NORTH AMERICAN CONTINENT

TWO 40-h.p. boilers have recently been installed by the York County Gas Co., of York, Pa., U.S.A., for supplying steam automatically to prevent winter freeze-up of the water in a 2-mill. cu.ft. gasholder. Hitherto, steam had been supplied also for production purposes from a central boiler installation, but, on going over to natural gas, a much reduced supply was required, rendering the old boiler uneconomic.

A changeover was therefore made, using gas as fuel, to two automatically controlled boilers installed near the gas holder which alone they would serve. Two boilers, rather than one 80 h.p. boiler, were installed so that steam could be supplied according to load conditions, since about one-half the maximum requirement was sufficient during the spring and autumn. The boilers were so controlled that either boiler could be used at any time or the boilers could be used together under mid-winter conditions. Each boiler is of the cylindrical, vertical, fire-tube type fitted with insulated bases and up-shot secondary air burners. Each operates at a minimum efficiency of 75% and is independent of the other. Anticipating controls are fitted so that the boilers can be started up prior to actual cold weather conditions. These include outside thermometers which automatically and electrically ignite gas pilot flames monitored by approved combustion safety equipment, the actual burners being started after the pilots have been ignited and proved. Of the two outside thermometers used, one is set at approximately 40°F. and the other at approximately 35°F.

Dual pressure control devices give a suitable flame for low steam requirements and provide a low-flame starting condition. These are electrically interconnected with a dual manifold system to meter the amount of fuel input according to boiler demands. Each burner is protected with individual electronic combustion safety relay systems with electric ignition, and the control system incorporates the various valves for final shut-off, as well as the necessary valves to be actuated by the control equipment. Each boiler is further safeguarded by an auxiliary low water cut-off.

Secondary air finds access to the combustion chamber through openings around the periphery of the base of the insulated chamber. These openings also provide for cooling there. Maximum heating efficiency is obtained with an atmospheric type secondary burner which does not require compressed air for combustion so that the equipment can be fired in the event of an electricity failure. Each control circuit can also be operated manually in the event of a power failure. Electric tell-tale lights incorporated in the control panel indicate whether the system is functioning correctly, the control panel being located near to the boilers themselves.

Each boiler is fitted with an automatic water replenishment feed unit integrated with electric water valves for automatic operation. Injectors are also supplied for the manual admission of water in the event of power failure affecting the feed water pumps.

An insulated steam header takes the steam produced in either or both boilers to the gasholder and then to the elevated position at each lift. The system is antisiphoning and uses a steam bleed to prevent freezing in the flexible loops used to compensate for changing elevation. The steam is manifolded to the several locations at each level.

NATURAL gas from two nearby fields is being used to fire the boilers necessary for operating the mining equipment, using the Frasch process, at the world's first off-shore sulphur mine, recently placed in commercial production by the Freeport Sulphur Company in the Gulf of Mexico off the Louisiana coast. This process involves melting the sulphur underground by superheated water and forcing it to the surface in molten form with compressed air, the water and air being injected and the sulphur brought up through wells consisting of concentric pipes.

The heating plant, which is the third largest Frasch plant in the world, is designed to deliver an average of 5 mill. gal. of 325°F. water per day with a peak load in excess of 5.5 mill. gal. per day. Under average operating conditions it will burn 13 mill. cu.ft. of natural gas daily, produce 360,000 lb. of steam per hour at 600 p.s.i.g. and 600°F. generate 4,500 kW of electricity at 2,400 V and compress 2,500 c.f.m. of air to 1,000 p.s.i.g. Plant efficiency at full load is expected to be 93.5%, a 6.5% loss being attributed to radiation and stack losses.

Four Riley Type RX-15 pressurised furnace water-wall boilers, each having a capacity of 90,000 lb. of steam per hour are provided and a temperature of 600°F. is attained by superheating. The boilers are designed for gas firing only. One source of gas will meet normal demand and the other source will be for emergency use.

Each preheater is packed with two beds of ceramic rings and each is equipped with six North American 7 mill. B.t.u. per hour burners to supply the additional heat to raise the water from 140°F. to 190°F.

FORECASTING a rapid upsurge in the use of natural gas in Canada, Carl O. Nickle, publisher of the *Daily Oil Bulletin*, predicted the gas industry will spend $7,130 mill. on exploration, development, production costs, royalty payments and gas utilisation, by 1968.

Speaking to more than 300 chief executives of the gas industry gathered in Murray Bay, Quebec, for the annual meeting of the Canadian Gas Association, Nickle said that natural gas will replace the mining and petroleum industries as Canada's top natural asset during the 60's and will be a major factor in shaping Canada's economy.

'By the end of 1968, the industry will total up an outgo of about $11,900 mill.' At first glance, Nickle said, one might be pessimistic about the ultimate profitability of the Western Canadian industry, but this was not so.

Spurred by gas expansion, he explained, the industry faces the biggest income and outgo in its history, and the largest of any Canadian resource. It will spend more than it takes in for three years, but annual deficits will be rapidly reduced, and will be turned into the first annual gain by 1963. By 1967 the industry will enjoy its first $1,000 mill. revenue year, with a forecast net gain over outgo of $169 mill. Revenue over outgo will increase until it reaches $2,000 mill. annually in the 1970's.

THE Metropolitan Leather Co. Ltd. have now opened a new gas meter diaphragm testing and research laboratory at their Great Harwood, Lancashire, factory.

Included in Metropolitan Leather's research programme are investigations into the suitability of a wide range of modern synthetic materials for use as gas meter diaphragms as well as continued research into the physical and chemical properties of leather.

A great deal of the equipment is of unique design and is intended to test new products so thoroughly that the need for subsequent field trials is virtually eliminated.

The fact that Metropolitan Leather have established their new testing and research laboratory at this time is of particular significance to the British gas industry since it is now common knowledge that considerable changes are planned in the make of gas in Britain over the next few years. Before studying the problems which will confront such leather diaphragm manufacturers as Metropolitan Leather as a result of these changes, it is useful to understand the problems which faced the American gas industry when they changed their domestic gas supply from coal to natural gas.

High relative humidity

The original American gas made from coal had, in the main, a high relative humidity and was fairly rich in both saturated and unsaturated hydrocarbons. Among these volatile hydrocarbons were members of the benzole series which are extremely active solvents and which tend to be scrubbed from the coal gas by oils.

The Americans subsequently changed to natural gas which was extremely dry and contained around 95% methane, the remainder being the next highest members of the paraffin series in gaseous form.

During the life history of American gas meters on coal gas—all of which used 'bag' type leather diaphragms made from full grain New Zealand sheepskins and oiled with mixtures of oils according to the preferences of meter manufacturers and gas companies—the oil dressings had scrubbed hydrocarbons from the coal gas. The dressings had therefore become diluted, lost their viscosity and partly drained from the leather.

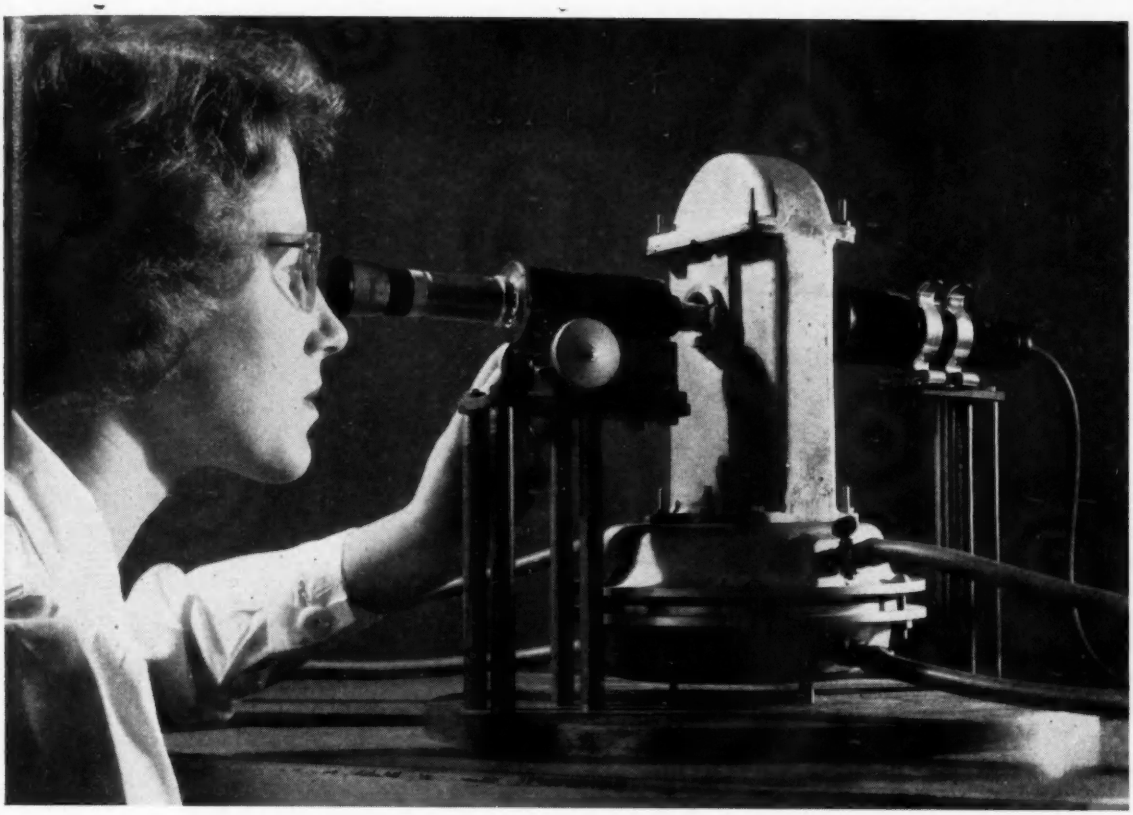
Thus the diaphragms were, in effect, oiled with oil dressing plus condensates—in some cases mainly the latter.

An assistant operating a Bally Tensometer which graphs the plastic/elastic properties of a leather diaphragm.

Solving

Part of the chemical laboratory in the diaphragm testing and research laboratory of the Metropolitan Leather Co. Ltd. at Great Harwood, Lancs.

This technician is using a gas meter calibrating unit which has been designed in the laboratory to measure meter oscillation' electronically.



An assistant in the laboratory measuring the total stroke on a single diaphragm test apparatus.

meter diaphragm problems

The gas meter and diaphragm test unit in the new laboratory. The refrigerator in the left foreground houses gas meters and single diaphragm test apparatus.

In areas where the gas supply had been very wet, water tended to be absorbed by the hydrophylic leather and gradually replaced the oil dressing, or, at best, formed an emulsion containing water, condensate and oil dressing. This effect was exaggerated in gas supplies containing small amounts of ammonia. The ammonia itself, by altering the *p*H of the leather, caused it to harden and shrink.

Additionally, coal gas supplies are notorious for the way their composition varies with climatic and economic conditions in summer and winter. If the original coal gas supplies had remained reasonably constant, in most cases equilibrium conditions would have been set up between the oiled diaphragms and the gas supply. Seasonal fluctuations prevented this and tended to exaggerate the undesirable extraction effects on the oil dressing. Nevertheless, some sort of rough equilibrium was established in districts served by individual coal gas supplies.

When the Americans suddenly changed to natural gas, any semblance of equilibrium was completely upset. The dry gas acted like a dessicating agent and promptly removed the water and the volatile hydrocarbons. The result was that the leather diaphragms lost nearly all their dressing and then became dry and chemically hardened.

Because natural gas is normally extremely dry and

Continued on p. 108

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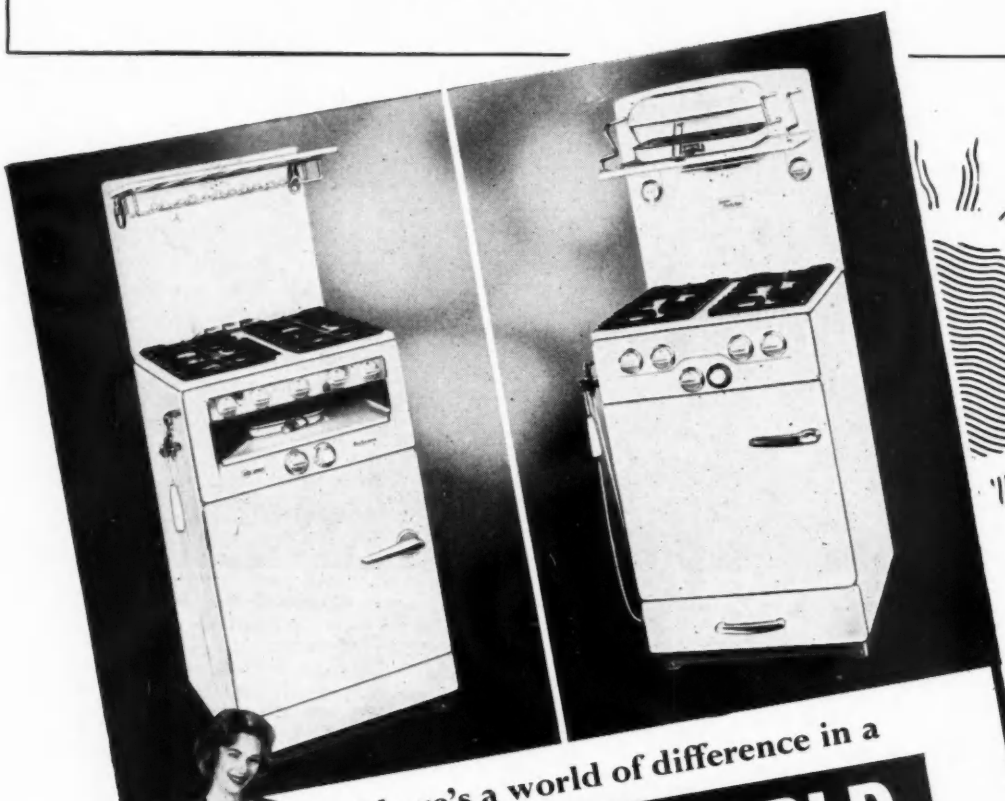

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From a paper to the Manchester District Junior Association of Gas Engineers, Partington, February 24.

Some aspects of water treatment

By L. G. TOWNSEND, M.Sc., F.R.I.C., M.Inst.Gas E., M.Inst.F.
CHIEF CHEMIST, MERSEY GROUP, NORTH WESTERN GAS BOARD.

DURING the last few years the demand for water has increased both nationally and internationally, and this increase continues from year to year. At the present time, the country is using about 4,000 mill. gal. per day, and by 1965, this is expected to reach 4,500 mill. gal. per day. It can be estimated that of this total, only a very small proportion is used domestically, say 10% or so, and the remainder is shared between agriculture and industry almost equally. With such vast amounts of water being used, it is not surprising that it has increased in value to such an extent that it is no longer profitable to throw water away until the fullest use has been made of it. This in turn, has focussed attention on methods of improving water usage, and many of these methods involve chemical treatment. The gas industry itself, has made very great economies in the use of water and water cooling, and circulating systems are now the rule. Thirty years ago such systems were unusual and many difficulties arose with the initial installation. These have now been largely overcome.

Treatment for steam raising

The treatment of water for steam raising at low and medium pressures cannot, for obvious reasons, be covered exhaustively, but some items of particular interest to us in the gas industry may be dealt with. The size of industrial units, including our own, is now such that the chemist is asked to deal with problems concerning water from all or some of many possible sources. The main objects of treatment in this case are (a) the prevention of corrosion in the boiler, (b) the avoidance of scale formation in the system, and (c) the maintenance of clean non-corrosive steam. All these objects are to be accomplished with as little heat loss as possible, and at minimum cost, factors which are not always kept in mind.

Waters available for steam raising are from:—

1. Lakes, which contain almost entirely surface waters with little mineral salts, but saturated with oxygen from the air. These waters are soft, but may be aggressive and they contain much plant life. Temporary and permanent hardness are about equal.

2. Rivers, which vary much more widely than the previous class, but are generally similar. They are, however, much more subject to industrial pollution and for this reason oxygen content is often lower. Plant life is still plentiful and tidal reaches will show relatively high salt contents. Hardness, particularly at low flows, can be quite high.

3. Streams, which are generally much more variable and since they often arise from underground springs, the water from them may be quite hard.

4. Deep wells and boreholes, which give sterile water containing very variable amounts of soluble salts. Hardness is usually higher than the other classes. In some areas, *e.g.*, West London, boreholes yield water which contains free bicarbonate of soda, and the hardness is all temporary.

5. Canals, water from which needs careful examination over long periods to establish its suitability. Pollution by industrial wastes may be severe, and suspended matter may be a problem.

6. Underground workings, water from which is frequently acid in reaction and contains finely divided organic matter. Such water is, in general, variable in composition and is not suitable for steam raising purposes, since appropriate treatment may be difficult and costly.

Table 1. taken from B.S. No. 2486, gives the composition of various types of water in this country.

TABLE 1
Composition of Natural Waters
(Great Britain)

Source	Dissolved solids	Alkaline hardness expressed as $CaCO_3$	Non-alkaline hardness expressed as $CaCO_3$
	ppm.	ppm.	ppm.
Southern rivers and lakes	300—500	200—300	20—100
Northern rivers ..	200—300	150—200	50—100
Northern streams and lakes	50—100	20—50	10—30
Normal well waters ..	300—600	300—350	20—500
Canal waters ..	extremely variable		
Estuary waters* ..	200—500	200—350	70—100

*Will vary according to extent of sea water contamination and can be much higher than the above figures.

The methods of treatment available can be divided into three main classes—(a) precipitation (b) ion exchange (c) internal treatment in the boiler, which is a special case of (a).

Composition of the water

The choice of method will depend on the composition of the raw water and the main factor here is the relation between the bicarbonate and carbonate hardness and the calcium and magnesium salts. It is also evident that treatment which may be quite satisfactory for boilers working at 100 p.s.i., will not necessarily qualify when the pressure is raised to say 400 p.s.i., and will certainly be deficient for boilers working at 1,000 p.s.i. As the boiler pressure increases, so does the potential damage which can arise from scale formation and corrosion become more important. This, in turn, not only calls for additional care in choosing the right kind of treatment, but also demands additional plant to remove dissolved oxygen. Conditioning of the boiler water itself, by the addition of very small amounts of chemicals to the boiler itself, or to the feed

water, also becomes important as the pressure increases. Softening in the boiler of any scale, is only practicable at low pressures up to 150 or 200 p.s.i., and with water of relatively low hardness say, below 60 ppm.

Precipitation methods are, in general, based on the use of lime and sodium carbonate and produce an acceptable water for most low and medium pressure boilers. The feature of the chemistry of the process is the relative solubility of compounds, which are generally regarded as insoluble and the slow speed of precipitation reactions, when only small amounts are involved. The success or otherwise of the process, depends on operating at elevated temperatures with excess of reagents and the use of flocculation and crystal seeding methods to ensure the completion of precipitation.

The lime soda process

The first disadvantage of the lime soda process is failure to produce a completely soft water. Even in the most favourable circumstances, the residual hardness will be in the region of 10 to 20 ppm. Very serious difficulties can arise when insufficient care is given to the completion of the softening reactions, and these are particularly common when a cold lime soda plant is overloaded; 'after precipitation' is always to be guarded against, and such plants should never be overloaded for long periods. This is rarely necessary, since comparatively minor alterations can increase the capacity of all but the most modern plants. Phosphate addition, at the correct point, is also helpful in these circumstances, and the use of coagulants to assist precipitation should always be borne in mind.

It is evident that the removal of calcium temporary hardness with lime leads to a small reduction in the total dissolved solid content of the water and this may be regarded as a slight advantage. It can also be claimed that carbon dioxide is also removed in the process, and with average amounts of permanent hardness in the raw water, there is usually sufficient sodium sulphate in the treated water to act as a safeguard against caustic embrittlement. A disadvantage of all precipitation processes lies in the difficulties of disposing of the effluent sludge.

From the point of view of control the process is reasonably straightforward. Excess of lime gives caustic alkalinity in the treated water and leads to high usage of soda ash, so that chemical control can be adequately exercised by the determination of hardness and the caustic and carbonate alkalinity in the treated water. The blow-down return process or the direct use of caustic soda is another variant of the method but, except in rare circumstances, they are appreciably more costly. This also applies to a greater degree, to the use of barium salts for softening, which is applicable in special circumstances. This method is more popular in the United States than in this country.

Ion exchange processes are carried out with many variants, a combination of which can result in the production of water which is as good, or better, than distilled water. The old established sodium cycle base or cation exchange process, originally used naturally occurring sands of the greensand variety, which replace calcium and magnesium for sodium. These zeolites are complex sodium aluminium silicates. Regeneration is by means of strong brine solution which, apart from the replacement of zeolite at long intervals, is the only reagent. Control of the process is simple and an almost dead soft water is produced.

This particular method operates with a salt efficiency of 35 to 45%, and the naturally occurring zeolites are extremely robust, although the exchange value does not usually exceed 250 g. per cu.ft.

Artificial zeolites prepared from sodium silicate and aluminate, have gradually replaced the natural sands, since they possess much higher exchange capacities—up to two and half times that of the natural product, on a volume basis. They also give a much better salt efficiency when used at low exchange values, comparable to those obtainable with the natural zeolite. The artificial exchange material is, perhaps, not quite so robust, since it is said to prefer water which is substantially iron free and relatively narrow in *p*H range. Nevertheless, with normal care it is entirely trouble free, and its advantages are so marked that it is gradually replacing the natural sands.

In addition to the cation exchange materials already mentioned, the discovery of carbonaceous zeolites which would exchange cations for sodium or hydrogen, was a further step forward. These materials are manufactured by the sulphonation of carbonaceous material, such as coal or coke, and possess very high exchange values. Small deposits of natural carbonaceous zeolite have been found. They are relatively robust, and when operated on the hydrogen cycle they are regenerated with hydrochloric or sulphuric acids instead of brine. The treated water from a raw water containing only temporary hardness, will only require carbon dioxide removal to produce boiler feed, but other waters will require further treatment to neutralise the acids produced. An elegant solution to this problem of acid removal can sometimes be achieved by running two plants in parallel, one of which is on the hydrogen cycle, and the other on the sodium cycle. A further advantage of many of the synthetic resins, for example, the polystyrene bead type, is that they can be operated at elevated temperatures without deterioration. Natural products will not handle hot water. Such resins can be operated at an exchange value as high as 1,500 g. per cu.ft., with a salt efficiency of 60%. The salt efficiency is higher at lower exchange values.

Cation exchange material

In addition to cation exchange material, anion exchange materials have also become available of recent years. These materials will exchange anions for hydroxyl and they are organic resins containing amino groupings. They vary considerably in their properties, but some strongly basic anion exchange compounds will even remove silicic acid. It is evident, therefore, that a combination of the correct choice of exchange resins will produce a water from which all ions have been removed. Such a water when freed from dissolved gases, will be equal to distilled water, and will provide suitable make up for the most advanced types of boiler. The cost of such water is, however, comparable with the cost of distillation when the raw water is high in salts. In areas where the supply is relatively soft, this method is much cheaper than distillation and it is recommended unreservedly for the production of distilled water in the laboratory. Such small units can be obtained with 'mixed beds' of resin, and some industrial units operate in a similar manner. In general, anion exchange materials have capacities nearly twice as great as cation exchange compounds.

Cation exchange has many advantages and some disadvantages. Such units are simple, and can be operated automatically and give soft water. The effluent disposal is without difficulty, and control is extremely simple. On the other hand, the dissolved solids are increased slightly in the treated water, which is often inordinately high in sodium bicarbonate. Where the raw water is high in temporary hardness, the method must give way to lime treatment, but it is ideal for all small scale softening duties.

The treatment of raw water in the boiler itself, is a compromise and, as such, is rarely completely successful.

Since most softening plants do not consistently provide completely soft water, the installation of such a unit can hardly be contemplated when the raw water hardness is less than, say, 60 ppm. Nevertheless, even 60 ppm. of hardness can accumulate a very considerable amount of scale in 14 months. With a small boiler raising 5,000 lb. of steam per hour, the amount of scale and sludge deposited would be in the region of a ton and a half and steps must be taken to ensure that the material does not adhere to the boiler surfaces, and is rejected as far as possible in the blowdown.

The basis of internal treatment must follow similar lines to that for external softening, bearing in mind, that precipitation must be confined to the boiler and should not occur to any extent in the feed lines. Where lake water or moorland water is used, the temporary and permanent hardness are often about equal, and this is usually the case when internal treatment is practised. Since sodium carbonate at low pressure is converted to sodium hydroxide in the boiler to the extent of about 40%, the only chemical which is patently necessary for complete softening, is sodium carbonate. The increased *p*H resulting from the use of soda ash also assists in controlling corrosion in circumstances which are otherwise aggressive towards metals. Hardness salts should be precipitated as a soft free settling sludge and not on the evaporating surfaces as an adherent scale.

Calcium carbonate and magnesium hydroxide both precipitate as a relatively innocuous sludge, since nearly all calcium salts, however, become less soluble as the temperature rises, they also have a tendency to appear on evaporating surfaces, where the concentration is highest. Calcium sulphate is, of course, much more soluble than calcium carbonate but, nevertheless, calcium sulphate scale can be deposited when the concentration of sulphate ions is sufficiently high.

By controlling the relative concentration of the sulphate and carbonate ions, it is always possible to ensure that the solubility product of calcium carbonate is exceeded before that of calcium sulphate is reached. This is generally referred to as 'carbonate conditioning,' and was the result of Hall's work in America as long ago as 1927. The general principles are as sound now as when originally proposed, and the basis of all internal treatment rests on the maintenance of appropriate carbonate/sulphate ratios.

In spite of 'carbonate conditioning,' however, difficulties still arise with internal treatment, and recently Gray has proposed an empirical approach to this problem, which can be applied to boiler pressures up to about 200 p.s.i. The method consists in maintaining the magnesium hardness above a certain minimum, which is related to the calcium and silica in the feed. This is, in turn, associated with a maintenance of 250 ppm. of carbonate alkalinity in the boiler. It is claimed that by this method non-adherent (mobile) sludges are produced.

Internal treatment methods

In addition to these methods of internal treatment, a very wide range of substances have been recommended at one time and another for preventing the formation of adherent scales, and assisting the formation of rapidly settling sludges. Organic compounds, such as starch and tannin, and materials containing them, have been used for many years and there is no doubt that in certain circumstances, they are beneficial but in many others they are quite useless. It is well to remember that the state of affairs inside a water tube boiler on load must be, to say the least, highly turbulent. Considerations concerning the settling of sludge in these circumstances are quite irrelevant, and any precipitation must be spread evenly through the water. Precipitation will be taking place continuously at the heating surfaces, so internal treatment can never give a boiler which opens up completely without sludge and scale deposits.

No mention has so far been made of the occurrence of scales due to silica. It is natural, that as the main scale difficulties are disposed of, other minor ones come into prominence and it so happens that silica either alone, or in combination with aluminium gives rise to very hard persistent scale. It is certain that the silica in the water is present as a soluble compound, and hard waters generally contain more than lake or moorland waters. Figures as high as 40 ppm. have been reported in hard chalk waters, where it is probably present as calcium silicate which is soluble in water containing carbon dioxide, but a more normal figure is about 5 ppm. Appreciable increases in silica content occur in base exchange softeners using natural sands, but this effect is quite small as is also the effect of pressure sand filters where the residence time is relatively short. The use of natural zeolites is becoming less common.

Significance of silica removal

Silica removal has some additional significance in the operation of high pressure boilers feeding turbo generators, since it seems probable that silica deposits on turbine blades arise from the carry over of silica in the steam in the form of a gaseous silicon compound. It could also be argued that since silica is always a constituent of boiler scales, it has a significant effect on the nature of the scale and the work of Gray already mentioned is of interest in this connection. Since calcium and magnesium both form dense adherent silicates, the complete removal of these from the boiler water is desirable.

The separate removal of silica is seldom practised unless boiler pressures are high. Normal lime soda softening, using sodium aluminate as coagulent, removes a proportion of the silica, and water from such plants would not normally exceed 5 ppm. of silica. A further improvement may be effected by the deliberate addition of magnesium sulphate or, more commonly, the oxide to the raw water entering the lime soda softener and recycling the precipitated sludge. Such treated water is suitable as far as silica is concerned for use at the highest pressures. The work of Straub suggests that at high pressures the silica in the boiler should be maintained below 5 ppm., and experiments have shown that, if this is done, turbine blade deposits are avoided.

No discussion of water treatment can ignore the desirability of removing corrosive gases such as carbon dioxide and oxygen, from the water before it reaches the boiler. Oxygen is very readily removed by de-aerators, and a certain amount of residual carbon dioxide from base exchange units can also be dealt with in this way. Oxygen removal is extremely thorough and no difficulty should be experienced in achieving a figure below 0.25 ml. per litre. It is evident, however, that little can be done at this stage to deal with the carbon dioxide which will arise in the boiler from the decomposition of any excess sodium carbonate, and this aspect will be dealt with later.

The production of a soft, clean, oxygen free supply of feed water, overcomes most of the difficulties which might arise in a steam raising plant, but certain further precautions are necessary as a safeguard against corrosion and scale formation, and priming.

Clearly there must be close control over the dissolved solids in the boiler water which, if allowed to become too high, would cause priming and foaming, and possible scale formation. This aspect is controlled by the blowing down of a small proportion of the boiler contents continuously

or at regular intervals. Due regard should be given to the heat content of the blowdown, which should be recovered where possible. Excessive blowdown should be avoided since it results in unnecessary heat losses and power consumption. The extent of the blowdown depends on the solids in the feed and the boiler pressure. The percentage blowdown should be calculated regularly, according to either of the following formulæ, and for a given feed should be reasonably steady.

$$\text{Blowdown as \% of feed} = \frac{\text{chloride in feed (ppm.)} \times 100.}{\text{chloride in boiler water (ppm.)}}$$

$$\text{Blowdown as \% of evaporation} = \frac{\text{Solids in feed (ppm.)} \times 100.}{\text{solids in boiler water} - \text{solids in feed (ppm.)}}$$

At low and medium boiler pressures, sodium carbonate conditioning of the boiler water is still the most satisfactory method in normal circumstances. The original work on this aspect was carried out by Hall in America some 30 years ago, and was based on the maintenance of carbonate: sulphate ratios, so that carbonate sludge was always precipitated in preference to hard sulphate scale. Later, solubility studies by other workers showed that the original figures were very much on the high side at low pressures, which gave an unnecessarily high factor of safety. With the very variable constituents existing in boiler waters, control methods of this kind based on a consideration of the solubilities of pure salts, are of very limited value. Where, however, difficulties are experienced with sulphate scale, the principles underlying the method should be borne in mind when modifications to treatment are contemplated. At low boiler pressures, sodium carbonate conditioning is still probably the most satisfactory method, but a check should be kept on the deposition of sulphate scale by relating the sulphate: chloride ratios in the feed and boiler waters.

The main corrosive agents will be carbon dioxide and oxygen and, in normal circumstances, the alkalinity of the boiler water gives good protection against the usual type of steel corrosion. It is assumed that de-aeration is practiced, when it is usual to remove the last traces of oxygen with sodium sulphite, slug fed into the boiler to give a reserve of about 20 ppm. The necessity, or otherwise, of this last form of treatment is best decided as a result of experience at low boiler pressures, but above 300 p.s.i. dissolved oxygen in the feed water should ideally be below .05 ppm.

Use of sodium sulphate

Some doubt has been thrown on the desirability of using sodium sulphite at very high boiler pressures, since there is the possibility of dissociation to give sulphur dioxide. In such cases hydrazine N_2H_4 has been used. This compound, which is a colourless liquid, boiling at 113°C. with a specific gravity of 1, reacts quantitatively with oxygen to give only nitrogen and water as products and, therefore, has no effect on the boiler solids. Since excess hydrazine decomposes in the boiler to ammonia and nitrogen, it is essential to add the hydrazine in about 100% excess to the feed water well in advance of the boiler. The pure compound is toxic and rather unpleasant to handle, but it is supplied in the form of an aqueous solution of the hydrate, which presents no difficulty, but its use is generally confined to high pressure boilers.

Steam containing large amounts of carbon dioxide can be extremely corrosive, especially at medium and high pressures, and what steps are necessary to cope with this difficulty are best decided in the light of experience. Good de-aeration and feed water control are usually all that is required, but in extreme cases, volatile alkaline materials can be added to the boiler.

Hydrazine provides ammonia, but a more useful compound for this particular purpose is cyclohexylamine $C_6H_{11}NH_2$. It is a clear colourless liquid with a specific gravity of .87, boiling at 135°C.; the *p*H value of a solution of 100 ppm. in water is 10.5. The solution has a similar smell to ammonia, and it is additionally useful for *p*H control as well as being volatile in steam and thus protecting the steam lines. Filming amines, such as octodecylamine ($C_{18}H_{37}NH_2$) are used in a rather different way in that they spread a protective film on the metal surfaces of the steam lines, without neutralising the acidity. Their effect is short lived, and continuous addition is essential but obviously the demand is considerably less than for neutralising materials. They are useful even at low pressures.

Sodium carbonate conversion

As boiler pressures rise the conversion of sodium carbonate into caustic soda and carbon dioxide increases, and may be as high as 80%, although a figure of 40 to 50% is more usual at low pressures. The extent of the conversion depends very much on the composition of the water and local conditions, so that it is not possible to draw a curve showing a universal relationship. The increased conversion at higher pressures poses two problems, *viz.*, the development of excessive caustic alkalinity in the boiler with loss of carbonate, and the evolution of carbon dioxide which passes away with the steam. The difficulty of excessive caustic alkalinity can be overcome by replacing carbonate partly by phosphate, which is quite stable in the conditions obtaining.

With a phosphate reserve in the boilers, any precipitation will be as calcium phosphate or the related hydroxy-apatite, both of which are precipitated as sludges, provided an adequate alkalinity is maintained. Control consists of maintaining a caustic alkalinity of 10-15% of the T.D.S. while, at the same time, ensuring a phosphate reserve of the order of 30 ppm. The phosphate is frequently supplied in the form of the hexametaphosphate, but any of the three sodium orthophosphates can be used, depending upon the reduction of alkalinity required. Alkaline conditions must be maintained, since this ensures not only the correct precipitate, but also the most effective use of the relatively expensive phosphate ion. Apart from alkalinity considerations, however, the use of the hexametaphosphate is otherwise attractive, since it does not immediately precipitate phosphates on addition to water containing calcium ions and, therefore, may be added to the feed without danger of precipitation in the feed lines. This is true at all ordinary temperatures, but if the feed water is above 140°F., the protection is only partial and economisers may still develop deposits. In such cases, slug feeding direct into the boiler or through the feed lines provides a solution.

Metaphosphate is converted to orthophosphate in the boiler as follows:

$$Na\ PO_3 + 2NaOH = Na_3PO_4 + H_2O$$

The same considerations apply to phosphate conditioning as were proposed by Hall for carbonate, and the solubility product of $3Ca^{\cdot\cdot}$ by $2\ PO_4^{\prime\prime\prime}$ should be exceeded before that of $Ca^{\cdot\cdot}$ by $SO_4^{\prime\prime}$. For much the same reasons as applied to carbonate conditioning, it is not satisfactory to specify definite values of the ratio $PO_4 : SO_4$ and control is by the maintenance of a reserve of phosphate in alkaline conditions.

Caustic embrittlement is a form of corrosion, which is fortunately not within the experience of most gasworks chemists. It first gave considerable trouble in America almost 50 years ago, and appeared to be associated, in

many cases, with the use of base exchange softening. It takes the form of inter granular cracking of the boiler metal, and its effects can be very disastrous. Investigations by Straub and his co-workers, led to the conclusion that the cause of the trouble was a high concentration of caustic soda at a position where the metal was under a highly tensile stress.

Laboratory experiments showed, however, that relatively high concentrations of caustic soda were required to produce metal failures—at least 100 g. per litre (100,000 ppm). Concentrations even approaching this are never experienced in practice, and it is necessary to assume that concentration of the boiler water must occur at the site of failure. This could quite readily occur at leaking riveted seams, and could normally pass undetected. This affords a possible explanation of the mechanism, particularly as failure by caustic embrittlement frequently occurs at riveted joints or welded seams, which have not been sufficiently stress relieved.

Straub's work indicated, also, that embrittlement was dependent not only on the concentration of caustic soda, but also on the sodium sulphate and sodium carbonate concentrations. Sodium sulphate could inhibit this form of attack and curves were drawn showing the control requirements in the form of Na_2SO_4 : NaOH and Na_2CO_3 : NaOH ratios. These curves show that if a Na_2SO_4 : NaOH ratio above 2.5 is maintained, all should be well.

In America the nitrate : alkalinity ratio has replaced the sulphate : caustic soda ratio and, so long as this is maintained above .3, embrittlement will be most unlikely. Clearly with all welded boilers, properly stress relieved, the difficulty should not arise. With very high pressure boilers it is becoming increasingly popular to control the *p*H by means of phosphate addition, using the *p*H of trisodium phosphate as a guide.

Solving meter diaphragm problems

Continued from p. 99

contains no higher members of the various hydrocarbons, no powerful solvents of the benzole series and no injurious chemicals such as ammonia and cyanide, disc type leather diaphragms function perfectly for almost indefinite periods.

On the other hand, bag type diaphragms—the type still used in American gas meters—of oiled leather have the inherent tendency to collapse on the top periphery. Consequently, the Americans gradually went over, with many troubles on the way, to bag type diaphragms of coated cambric cut on the bias to give some measure of flexibility. This material was much stiffer than leather and, in the initial design which tried to copy the shape adopted for leather, flexing troubles were experienced. These were subsequently overcome by changing the diaphragm profile and the method of forming.

Although changes anticipated in Britain are not exactly parallel to those which took place in America—and in any case, all British gas meters use disc type diaphragms in order to reduce meter size—new makes of British gas with their greater purity, lower humidity and lower content of both saturated and unsaturated hydrocarbons will tend to dry out and harden oiled leather diaphragms which have been working for some years on the older types of gases.

If a material could be found possessing the necessary physical properties plus the chemical inertness and stability against the effects of the gaseous constituents in the old and new makes of British gas, then the difficulties which might be expected to arise in Britain during the gas supply changeover phase could be obviated.

The method of mounting diaphragms has also received great attention since early research revealed that the mounting methods applicable to leather diaphragms were quite unsuitable for other materials, including polymer, owing to their different physical properties.

Designing a test rig for gas meter diaphragms poses a rather unusual problem. This is because, in the past, gas meters have been designed around the diaphragms and yet diaphragm performance has always been inferred from meter performance.

The new and unique test rigs in the Metropolitan Leather laboratory no longer rely on this old method. The laboratory houses six rigs, five operating at room temperature and one at a temperature controllable up to 170°F.

Specially designed diaphragm test units are installed which measure to a high degree of accuracy the total stroke and total displacement of single diaphragms. By this means, small changes in diaphragm performance can be measured and compared in the light of overall meter performance.

Gases currently being tested in the laboratory are:—

(i) Town gas
(ii) Humidified town gas
(iii) Benzolised town gas
(iv) Natural gas
(v) Liquid petroleum gas
(vi) Natural gas at 170°F.

In addition to testing with these six gases, gas meters and single diaphragms are tested in a low temperature refrigerator using natural gas at a temperature of −50°F.

The gas industry has known for some time that the methods used to calibrate gas meters have been subject to a number of inherent errors arising from difficulties of temperature and humidity control. Although the performance of gas meters is frequently reported to the second decimal place of percentage, the real reproducibility is of a very much lower order of accuracy. Experiments in the new laboratory are planned to improve the accuracy of reproducibility and already an electronic oscillation gauge has been developed which will replace the liquid manometer.

Since the elastomer materials being investigated in the laboratory have a physical 'memory' characteristic and a tendency to permanent and semi-permanent setting, a new apparatus has been designed so that the 'memory' properties can be fully examined.

All the physical testing in the laboratory is performed in an air-conditioned room at 70°F. and 70% relative humidity. A high temperature test room is also available and the chemical laboratory, which adjoins the physical test laboratory, is fully equipped for diaphragm material and gas sampling and analysis.

By running batteries of gas meters and single diaphragm test apparatus under closely controlled conditions in the new Metropolitan Leather laboratory, it will be possible to gain statistically significant information on the real performance of new diaphragm materials and of the meters fitted with them. This means that, for the first time, the gas industry will be in a position to accept or reject new diaphragm materials with a confidence based on scientifically established data. The industry will also save the time, expense and uncertainty attached to field trials in relatively unknown and uncontrollable conditions.

RESEARCH SHAKE-UP

Co-ordination of fuel development programmes

THE Minister of Power has reconstituted his Scientific Advisory Council. It will now advise on all aspects of fuel and power research and development from the laboratory to industrial application. The Council, whose Chairman is Sir Alexander Fleck, will be renamed the Advisory Council on Research and Development. Its work will be as follows:—

Dr. A. B. Badger, Industrial Relations Officer, the Gas Council, congratulates Mr. Goodwin after the presentation.

- To advise the Minister of Power on research and development in relation to his statutory duty of securing the effective and co-ordinated development of coal, petroleum and other sources of fuel and power in Great Britain, and of promoting economy and efficiency in the supply, distribution, use and consumption of fuel and power, whether produced in Great Britain or not;
- To advise the Minister of new scientific and technical knowledge or applications of knowledge throughout the world, which in the opinion of the Council should be taken into account in the performance of his statutory duties;
- To keep the whole field of fuel and power under continuous review with the object of identifying problems needing research and development and advising the Minister of these problems with a view to discussion with the industries concerned.

In order to co-ordinate the advice the Minister receives on research and development, the Council will absorb the Minister's Fuel Efficiency Advisory Committee, which is being wound up.

The Deputy Chairman of the Council is Captain (E) W. Gregson, C.B.E. Among its members is Mr. W. K. Hutchinson, C.B.E., Deputy Chairman of the Gas Council. Other members are:

Lieut-Colonel S. J. M. Auld, O.B.E., oil industry consultant; Dr. C. M. Cawley, C.B.E., Chief Scientist, Ministry of Power; Mr. T. B. Clark, Imperial Chemical Industries Ltd.; Sir Josiah Eccles, C.B.E., M.M., Deputy Chairman, Electricity Council; Dr. W. A. Macfarlane, C.B.E., Managing Director, National Industrial Fuel Efficiency Service; Sir Harry Melville, K.C.B., Secretary, Department of Scientific and Industrial Research; Mr. L. Rotherham, Member for Research, Central Electricity Generating Board; Professor M. W. Thring, University of Sheffield; Dr. F. A. Vick, O.B.E., Deputy Director, Atomic Energy Research Establishment, Harwell; Mr. A. H. A. Wynn, Scientific Member, National Coal Board.

Assessors will be: Mr. P. Chantler, Economic Adviser, Ministry of Power; Dr. E. Lee, Director, Stations and Industry Divisions, Department of Scientific and Industrial Research; Mr. H. T. Ramsay, C.B.E., Director, Safety in Mines Research Establishment.

£50 FOR IDEA

THE first £50 award under the Gas Council national suggestions scheme has been made to Mr. H. Goodwin, an assistant foreman in the industrial workshops at the Council's Watson House Centre. The cheque was presented to him at a meeting of the Gas Council by the Chairman, Sir Henry Jones.

Mr. Goodwin, 54, joined the Gas Light & Coke Company in 1932 as a fitter. He became an assistant working foreman in 1947 and assistant foreman in 1958.

The suggestion for which he has received the Gas Council award is a modified assembly of a flame protection valve which fitters can use to ascertain whether thermocouples or thermo-electric valves are defective.

In addition to Mr. Goodwin's award, the Council has also made nine smaller awards under the scheme.

NEWS SUPPLEMENT

RoSPA to hold safety course

THE Royal Society for the Prevention of Accidents (RoSPA) is to hold a one-week residential course for safety officers in the building and civil engineering industries.

The course will cover both theoretical and practical aspects of the work. In one study period, for example, trainees will be asked to spot and correct faults in scaffolding under the expert guidance of Major D. K. Edwards, of Scaffolding (Great Britain) Ltd.

The course will be held at the Civil Defence Staff College at Sunningdale, Berks, on November 13-18, 1960. The inclusive fee will be £25.

All enquiries should be made to the Training Officer, Royal Society for the Prevention of Accidents, Industrial Safety Division, Artillery Mansions, 75, Victoria Street, London, S.W.1. (Abbey 6963/7).

WHITBY NATURAL GAS HOLD-UP

THERE has been some delay in the work in the Esk Valley around Aislaby and Gromont in tapping the supplies of natural gas discovered in this district earlier this year.

Householders in Whitby had hoped their gas supply would have been supplemented by this time but it is now stated that the full supply will not be available until September.

Two wells have been opened and equipment at the well head for separation and pressure regulation has been ordered and will be installed very shortly. It will not be an extensive installation and will in no way spoil the natural amenities of the district.

Houldsworth Society

Present and former students of the Houldsworth School of Applied Science at Leeds University will meet at the Houldsworth Society's annual dinner, to be held on November 22 at the Griffin Hotel, Leeds. Gas engineering students and graduates will be among the engineers and chemists attending the dinner. The guest speaker will be Professor Evans, Head of the Civil Engineering Department. Tickets are obtainable from the Secretary of the Society at 15s. 6d.

In Parliament

Government looks at pipeline development

IN the House of Commons recently Mr. William Warbey (Lab. Ashfield) asked the Minister of Power Mr. Richard Wood, the form and scope of the examination being undertaken by the Government into the problem of pipeline development.

Mr. Wood: 'I am consulting those concerned both inside Government departments and outside. In the light of the consultations, I will consider what further examination, if any, would be useful.'

Mr. Warbey: 'Will the examination have as one of its purposes to ensure that future pipeline development takes place in accordance with a rational plan based on clearly established national need?'

Mr. Wood: 'That will be the whole purpose of the inquiry.'

Wilson Committee

Mr. W. Hamilton (Lab. Fife W.) asked the Minister of Power when he now expects to publish the Report of the Wilson Committee inquiring into the potentialities of the by-products of coal.

Mr. Wood: 'The Chairman has told me that he hopes the committee's report will be completed in the very near future. I shall then arrange for its presentation to Parliament as soon as possible.'

Mr. Hamilton said there was a great volume of opinion in the country which believed that the future of coal lay in its by-products rather than in its burning.

Undistributed stocks

Mr. Wood told Mr. Gerald Nabarro (Con. Kidderminster) that the undistributed stocks of coal of just over 34 mill. tons and about 5 mill. tons of coke on June 18 were valued at about £135 mill. The corresponding figure at the beginning of the year was slightly more than £140 mill.

Mr. Nabarro commented that stocks were 7 mill. tons higher than on the same date last year. The Minister should give much more urgent attention to the 'drain, a drug on the market.'

EASTERN FLAT-RATE CONSUMERS TO PAY 4d.—6d. A WEEK MORE

MR. J. H. DYDE, Chairman of the Eastern Gas Board, told the Eastern Gas Consultative Council at a meeting this week that in general the flat rate price of gas would be increased by 2½d. a therm, the additional cost to the average domestic consumer being between 4d. and 6d. a week. The changes would become effective from meter readings following July 23.

Explaining the increase, Mr. Dyde said that the Board, in accordance with its policy of providing stability in prices for as long as possible, had maintained the tariffs introduced in 1957 although there had been considerable increases in the Board's costs.

The total increase since 1957 mainly due to increased wages, salaries and pensions and capital charges was no less than £1.3 mill. per annum.

Administrative economies and planned improvements in efficiency had saved some £350,000 a year and the Board intended to absorb another £200,000 per annum of these additional costs.

Employees had been reduced in number over the past three years by 512.

Mr. Dyde recalled that on October 1 last the Board introduced a special tariff particularly for central heating and space heating loads. This had enabled the Board to break into the central heating market and was to remain unchanged.

The critical consumption—the point at which it became advantageous to a consumer—was 209 therms a year.

Another two-part tariff for domestic consumers, of which the critical consumption was 131 therms a year, had been in operation for three years and a small increase in the commodity rate had now been applied.

The consumption of about one in four householders was sufficient to make the two-part tariffs advantageous to them.

For non-domestic consumers taking gas under two other tariffs the increase had been limited to the first 100 therms per quarter only.

The tariff for non-domestic central heating and bulk hot water had been extended to cover the new warm air installations, and apart from one minor amendment remained unchanged.

'The Board is extremely conscious of the necessity to maintain a proper balance between the domestic and industrial loads,' Mr. Dyde said. 'They are complementary and there is no question of one subsidising the other. The Board is confident that the decline in domestic consumption per consumer will be arrested by the greater use of gas in central heating and space heating).

He added that most domestic consumers had a gas cooker and the installation of one or more major gas appliances generally meant that a consumer would immediately qualify for cheaper gas.

North Thames revises tariffs

NORTH THAMES GAS BOARD is having to revise its gas prices and tariffs in order to cover additional costs estimated at £700,000 a year. The introduction of economies and modern techniques has been unable to prevent these rising costs, which are largely due to the introduction of a shorter working week throughout the gas industry.

The changes, announced by Board Chairman Mr. Michael Milne-Watson at the area Consultative Council last week, take effect from the first meter reading after July 31. The increased costs will not be met by an increase in price per therm but by the recovery of certain basic costs through primary charges which will actually enable a reduction in many cases of ½d. a therm.

Standard rate tariff

The flat rate tariff will be replaced by a standard rate tariff under which the domestic credit consumer will pay a primary charge of 7s. a quarter, mains meter rents being abolished.

Slot meter users will pay a supplemental charge of 4½d. a therm on the first two therms a week instead of 2d. a therm on the first three a week as at present.

Non-domestic consumers burning gas on block rates will pay a smaller primary charge but will continue to pay meter rent.

The ½d. a therm reduction will apply to the flat rate, the first block of all block rates and the commodity rate of the ordinary domestic two-part rate.

Although non-domestic consumers will be affected by a number of altered charges and tariffs, the central heating and central storage hot water two-part rate will remain unchanged.

Mr. Milne-Watson stated that the increases would only amount to 1d. to 4d. a week for small consumers.

LONDON AND SOUTHERN JUNIORS' DAY OUT

THE London and Southern Junior Gas Association held their annual ladies' day in Southampton, at the invitation of the Southern Gas Board. Mr. R. K. Harrison, President of the Association, is an engineer in the pipeline division of the Esso Petroleum Co. Ltd., and was formerly regional distribution engineer with the Southern Gas Board.

Tour of docks

While the ladies were taken on a coach tour of Southampton docks and ocean terminal, some of the visitors toured Southampton works where they saw the two Onia-Gegi plants, the c.w.g. plants, tower purifiers, refinery gas purifiers and the new boosting and compressing plant supplying the Board's integration mains. Another party inspected the accountancy offices in Winchester Road.

Lunch was followed by a cruise round the docks and a coach trip from Hythe to Beaulieu.

Members of the Southern Gas Board who attended included Mr. C. H. Leach, Chairman; Mr. A. F. Hetherington, Deputy Chairman, and Mrs. Hetherington; and Dr. E. A. Haffner, Board Member and Chief Engineer, with Mrs. Haffner.

SIR ROBERT ATTACKS CURBS ON FREEDOM

DISQUIET that some local authorities were denying their tenants freedom of choice on fuels was expressed last week by Sir Robert Nimmo, Chairman of the Scottish Gas Consultative Council.

'Without this complete freedom the balance of competition is greatly disturbed,' he said, 'and the price of gas to the remaining consumers must necessarily be raised.

'In addition, any decision which denies the tenants freedom of choice does not take into consideration the wishes of the tenants or the ratepayers whom the Council represents.'

Sir Robert was speaking at a lunch given by the Scottish Gas Consultative Council in Cupar to representatives of Fife County Council, Cupar Town Council, and other guests.

He said that a Town Council had recently conducted a survey of the wishes of their tenants. They had found an overwhelming desire on the part of prospective tenants for freedom of choice, and the Council had since changed their all-electric policy.

CORRESPONDENCE

'A channel for public relationship'

DEAR SIR,

Three years ago I took office as Chairman of the Women's Gas Federation, no mean task for a housewife following, as I did, in the footsteps of chairmen of experience in the work of women's organisations and with a knowledge of the gas industry.

Very soon after my appointment my hopes and ideas for the Federation were sparked off by a very critical and forthright article in the 'GAS JOURNAL' to which I replied on behalf of our branches.

This article and my reply has ever been before me in my endeavours to do my best for the organisation. Always our aim is to link our branches more closely with the gas industry, to encourage our members to use the industry and to convince the industry that they have in the Federation an excellent channel for good public relationship, and should make full use of the branches.

All the time the Federation is growing in size, in strength and, we hope, in its use as a women's organisation. How best to encourage younger members is continually being discussed, and I feel sure our daughter branch in Lincoln will be followed by others. There is so much the Women's Gas Federation can do.

Naturally, I feel sad at retiring at a time when many plans are in process of developing, but I shall always maintain my interest in the Federation because, as a housewife, I still have much to gain from it, and I believe it is valuable for the housewife.

May I express here my thanks to all the friends I have made within and outside the industry who have helped to make my chairmanship so very worthwhile, and the last three years such happy ones.

GWEN EVERSHED,
5 Grosvenor Crescent,
London, S.W.1.
July 11, 1960.

Benzole recovery

DEAR SIR,

In the report of the discussion on my paper 'White Lund—Some Aspects of a New Works,' (June 22.), I am quoted as saying with regard to the economics of benzole recovery: 'By this means the altered yield of products is taken into account, and does not, in fact, alter the balance, in many cases.' This should read 'does, in fact, alter the balance.' The point I tried to make is that the true economics of benzole recovery are only shown by comparing the overall cost of gas manufacture with and without benzole recovery, i.e., after taking into account the increased yield of coke, tar and concentrated ammonia liquor per therm of gas made into holder, when extracting benzole. If the coal/coke price ratio is favourable then in many cases benzole recovery will break even or even show a slight profit.

Intensive oil washing affords an efficient means of reducing the organic sulphur content of gas, but the resultant increased production of coke per therm of gas made precludes its present use in all but the more exceptional cases. It can, however, be assumed that within reasonable time coke production will be more closely related to demand, in which circumstances oil washing may be considered once more. What is certain is that the industry cannot afford to continue to lose business because of the presence of sulphur impurity, in the vain hope that the load will be regained when 'low sulphur' gas becomes available at some undetermined future date.

Yours faithfully,

F. C. BUCKLEY,

Assistant Group Production Engineer,
Northern Group,
North Western Gas Board,
St. George's Quay,
Lancaster.
July 13, 1960.

Appliance sales still rising—but gas consumption falls again

SALES of gas appliances were maintained at a high level during the January to March quarter of 1960, and in the financial year to March 31, 1960. Gas cooker sales were 796,000, an increase of 19% on the previous year's sales.

Gas space heater sales increased by 50,000 (25%). Sales of water heaters increased by 35,000 to 233,000, an increase of 18%, and refrigerator sales rose from 50,000 to over 88,000. On the other hand, sales of wash boilers and washing machines fell from 231,000 in 1958-59 to 183,000 in 1959-60, a decrease of 21%.

Total sales of gas showed a fall of 0.7% over the year although industrial sales were 6% higher. Total sales in the January-March quarter were 3% higher than in the corresponding period of 1959 despite temperatures again being above average.

Provisional statistics of gas sales (not corrected for unread gas) show that, for the financial year, sales to domestic consumers were 3% lower than in 1958-59 and sales to commercial consumers 4% lower.

The average revenue per therm of gas sold remained unchanged at 21d.

The quantity of coal carbonised was 1.8 mill. tons lower than in the previous year and production of coal gas fell by 7%. Water gas production was 2% higher, but the amount of coke used fell by 1%. The quantity of oil used in making water gas increased by 5½ mill. gal. (4%). Total gas made was 4% lower, but purchases of surplus gas from coke ovens and oil refineries rose by 12%, so that total gas available was only 1% lower than in the previous year.

The output of coke in 1959-60 was 9% below the output of 1958-59, and sales of coke were 8% lower. Production of crude tar and crude benzole fell by 6% and 3% respectively.

New daily gas making capacity of 6 mill. cu.ft. was brought into use during the January-March quarter of 1960. The total capacity of new plant brought into use during the year was 55 mill. cu.ft., of which 20 mill. cu.ft. was carbonising plant. This compares with a total of 114 mill. cu.ft. in 1958-59 of which 28 mill. cu.ft. was carbonising plant.

More than 400 miles of new mains were laid during the quarter, bringing the total mileage of new mains laid in the year to 1,853, an increase of 8% over 1958-59.

Between the end of April 1959 and April 1960 the number of persons employed in the gas industry decreased by 5,300 to 125,700.

PERSONAL NOTES

LADY DAVIDSON, D.B.E., has been elected President of the Women's Gas Federation following the retirement of MISS K. M. HALPIN, C.B.E. (who held the office for ten years). Miss Halpin's association with the Federation goes back to 1935 when, at the request of the late Sir David Milne-Watson, she became the organising secretary. Her contact with the Federation will continue, as she has been elected a Vice-President. MRS. G. EVERSHED has retired after the customary three years as chairman of the Federation, and MRS. L. W. ROBERTS, a member of the Harrogate branch, has been elected Chairman. Mrs. Roberts has been a member of the Executive Committee for five years, and is a past chairman of the Harrogate branch.

MR. FRED SMITH, until recently area mechanisation engineer, No. 8 Area, North Eastern Division, National Coal Board, has been appointed District Technical Manager of Richard Sutcliffe Ltd. for the North of England. He will be responsible for all the company's sales activities both mining and industrial in the counties of Durham, Northumberland, Cumberland, Westmorland and the industrial Teesside area of Yorkshire.

MR. S. G. DEAVIN, O.B.E., has been appointed a Member of the North Western Gas Board. He will combine the duties of Board Membership with those of his present position as Secretary to the Board. Mr. Deavin, who is 54 years of age, has been Secretary to the North Western Gas Board since its inception. Before that he was secretary and accountant of the Preston Gas Company.

MR. H. R. HILL has retired from the post of chief development engineer of Bratt Colbran Ltd., and MR. H. WATTS has been appointed to replace him.

OBITUARY

MR. ERNEST WILLIAM WILSON, gas engineer, who held posts in Lancashire, Derbyshire, Dublin and Surrey during his 40 years in the gas industry, has died aged 78.

Company news

Whessoe Ltd.—27½% dividend

WHESSOE LTD. have declared a profit before tax of £990,130, as against a record figure of £1,229,338 last year. Total dividend for the year on ordinary stock is 27½%. The Chairman pointed out that the year has been difficult for manufacturers of capital plant of the Whessoe type. He further said that productive capacity for the company's traditional products would probably continue ahead of demand. For this reason attention had been given to widening the range of products and introducing new ones of advanced design and manufacturing technique.

* * *

Simon-Carves Ltd. and subsidiary companies have announced a net profit for 1959 of £825,000 after taxation, compared with £660,000 for the previous year. With a lower turnover, profits before taxation were 10% up on 1958. A total dividend of 35% was declared, compared with one of 25% for 1958. The Chairman's report mentioned work being obtained in South America, Yugoslavia, India (a fertiliser factory), and negotiations with South Africa, Rumania and other countries for supply of polythene plant.

* * *

The directors of the British Oxygen Co. Ltd. are proposing division of their ordinary capital into shares of 5s. each. B.O.C. £1 shares are quoted at £4 10s. 0d. on the Stock Exchange and the directors consider that adoption of smaller units with a proportionately lower value will result in a freer and wider market.

* * *

Glover & Main Ltd., having taken over James Stott & Company at a cost of more than £1 mill., recently declared a combined trading profit of £587,000. This figure is £109,000 down on last year and it was stated that the reason for this was the changes taking place within the group.

Coalite & Chemical Products Ltd. have declared a record profit before tax of £935,913. At 16½% their proposed dividend on ordinary stock is 3½% above last year, and continues the steady rise since 1951 when the total dividend was only 6%.

The Chairman's report states that despite competition from other domestic solid fuels, oil and electricity, and although a fine summer had been sandwiched between two mild winters, that demand for Coalite exceeded supply throughout the financial year.

COMING EVENTS

July 26.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster. 2.30 p.m.
July 27.—SOUTHERN G.C.C.: Administration Building, Esso Refinery, Fawley, near Southampton. 44th Quarterly Meeting. 11 a.m.
July 28.—NORTH THAMES G.C.C.: City Hall, Westminster.

PITLOCHRY REJECTS ALL-ELECTRIC SCHEME

PITLOCHRY Town Council has rejected a proposal that houses in a new scheme should be all-electric. Both gas and electricity are to be installed to give tenants a choice.

It was stated that the Scottish Gas Board would make a charge of £6 5s. per house for the installation of four gas points, but would not make any service charge, and that the Electricity Board would make a service charge where the tenant did not install an electric cooker.

NEW OFFICERS

MR. A. J. BLACKIE, Paisley, will be President of the Scottish Western Junior Gas Association for the new session, with Mr. A. M. Jackson, Dumbarton, as Vice-President.

PUBLISHERS' NOTICE

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